MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, SESSION 2017/2018

EEL3086 –SWITCHGEAR AND PROTECTION

(LE)

02 MARCH 2018
09:00 A.M - 11:00 A.M
(2 Hours)

INSTRUCTION TO STUDENT

1. This question paper consists of 4 pages including cover page with 4 questions only.

2. Answer all questions. All questions carry equal marks of 25. The distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided.

Question 1

(a) Define reliability, dependability and security of protection device. [6 marks]

(b) The performance of an overcurrent relay was monitored over a period of one year. It was found that the relay operated 14 times, out of which 12 were correct trips. If the relay failed to issue trip decision on 3 occasions, compute dependability, security and reliability of the relay. [5 marks]

(c) State the purpose of current transformer (CT), and potential transformer (PT) in the protection scheme. [4 marks]

(d) A fault current of 8500 A in a power system is transferred by a class C current transformer (CT) of 600:5, with a secondary burden of 3.5 Ω, and the secondray of CT is connected to a relay which is expected to operate for 7000 A fault current. Refer to Figure Q1d;

i. Check whether the CT will be saturated at this burden. [4 marks]

ii. Comment on the ratio error of the CT used. [2 marks]

iii. Replace the CT with a the highest value shown in Figure Q1d, and check again the CT saturation. [4 marks]

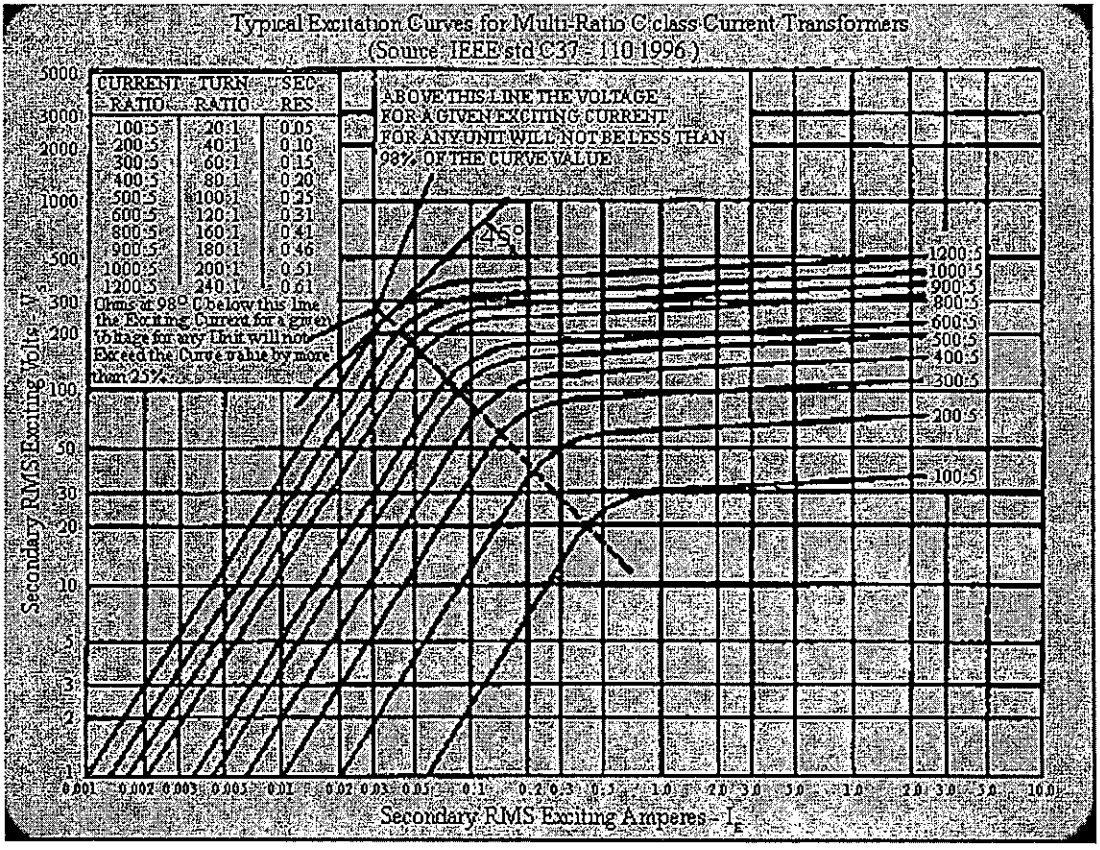

Figure Q1d

Continued...

Question 2

(a)

i. Discuss the operating principle of a SF6 circuit breaker used in sub station.

ii. List out three types of SF6 used for different voltges levels.

iii. List out two advantages and ONE disadvantage of SF6.

[7 marks]

(b) A 50 cycles, 3 phase alternator with grounded neutral has inductance of 1.6 mH per phase and is connected to bus bar through a circuit breaker. The capacitance to earth between the alternator and the circuit breaker is 0.003 μF per phase. The circuit breaker opens when r.m.s. value of current is 7500 A.

i. Determine the maximum rate of rise of restriking voltage.

ii. Write experession for restriking voltage.

iii. Determine the time for maximum rate of rise of restriking voltage.

iv. Determine the frequency of oscillations. [10 marks]

(c) A single-end-fed line protected by a 1 A IDMT relay is shown in Figure Q2c. The CT ratio is 200/1, plug setting (PS) is 1.5 A and time multiplier setting (TMS) is 0.2. Calculate the operating time of the relay separately for each fault shown in Figure Q2c. The characteristic of the relay at TMS = 1.0 is given in Table Q2c.

Table Q2c

PSM	2	3	4	5	10	20
Time. Sec	10	6.2	5	4.3	3	2.2

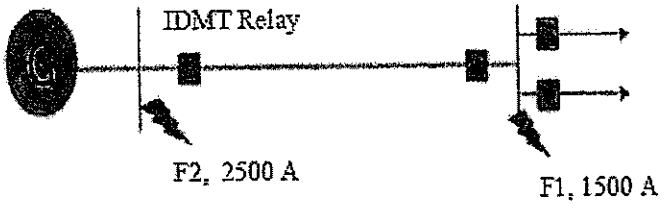

Figure Q2c

[8 marks]

Question 3

(a) What are the basic distance protection zones? Why different zones should be defined? Sketch the tripping characteristics of impedance, Mho and Quadrilateral relays. With the help of diagrams, explain the zones of protection.

[15 marks]

(b) Briefly define the FIVE basic characteristics of the protection which should be applied on relays in power system? [10 Marks]

Continued...

Question 4

(a) What is Plug Setting Multiplier ((PSM)? Explain PSM time setting mltiplier in Figure Q4b in details.

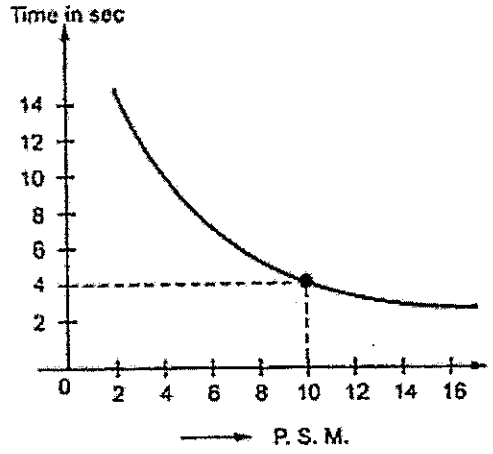

Figure Q4b

[6 marks]

(b) A three phase power transformer having a line voltage ratio of 400 V to 33 kV is connected in star-delta. The C.T.s on 400 V side have current ratio of 1000/5. Calculate the C.T. ratio on 33 kV side. Assume the current on 400 V side of transformer to be 1000 A. [8 marks]

(c)

i. Sketch the construction block diagram and operation block diagram of a Digital Relay. [3 marks]

ii. Discuss briefly the operation of the relay. [3 marks]

iii. List THREE advantages and TWO limitations of digital relays. [5 marks]

End of paper.